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BULLETIN No. 1

The Bulking of Sand and Its Effect on Concrete

BULLETIN No. 2

Low Cost Improvement of Earth Roads with Crushed Stone

BULLETIN No. 3

The Water-Ratio Specification for Concrete and Its Limitations

BULLETIN No. 4

"Retreading" Our Highways

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Reprint of "Comparative Tests of Crushed Stone and Gravel Concrete in New Jersey" with Discussion

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The Bituminous Macadam Pavement

BULLETIN No. 7

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The Effect of Transportation Methods and Costs on the Crushed Stone, Sand and Gravel, and Slag Industries

BULLETIN No. 9

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The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

NATIONAL CRUSHED STONE ASSOCIATION

1735 14th St., N. W.
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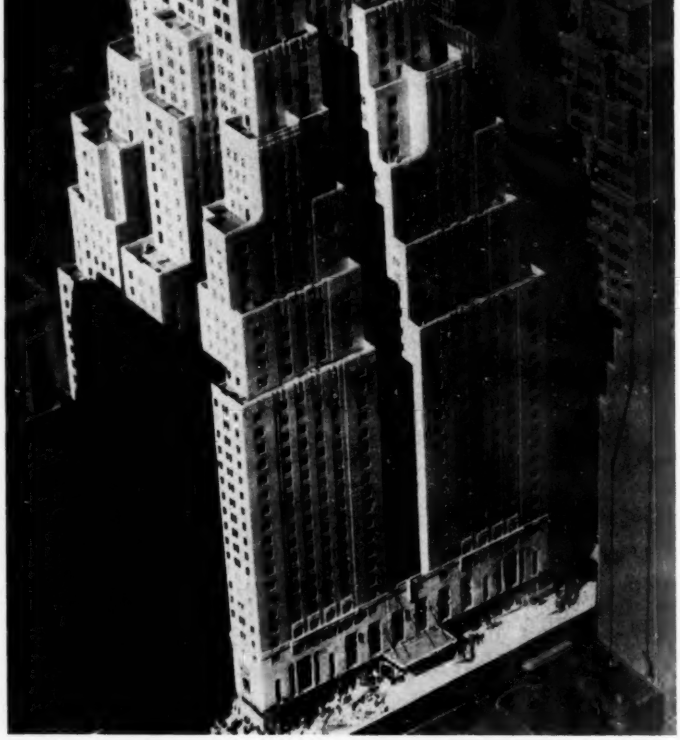

☆ *Hotel New Yorker*

NEW YORK CITY

Headquarters for the 27th Annual Meeting

THE CRUSHED STONE JOURNAL

WASHINGTON, D. C.

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Twenty-Seventh Annual Convention to be Held in New York City

THE Twenty-Seventh Annual Convention of the National Crushed Stone Association will take place at the Hotel New Yorker, New York City, on January 31, February 1 and 2, 1944. A most cordial and pressing invitation is extended to all interested in the crushed stone industry, directly or indirectly, to attend this important meeting.

In the following we shall endeavor to give a brief chronological preview of the highlights of the program.

The Convention will open at 10 a.m. on Monday morning, January 31, with Wm. M. Andrews, President, presiding. Immediately following his words of greeting President Andrews will give a summary of reports by regional vice presidents on business conditions during 1943 and the outlook for 1944. Reports will then be received from the Engineering and Administrative Directors; "How a Field Engineer Can Effectively Serve the Members" will be discussed by our newly appointed Field Engineer; and announcement of the various convention committees will bring to a conclusion the opening session.

As the feature for the Greeting Luncheon on Monday there will be presented the official motion picture of the War Department entitled, "War Department Report." In this picture the Army gives American industry the inside facts. The heretofore confidential material on which the film is based was first presented in a series of highly restricted War Department conferences to members of Congress and leaders of industry, labor, and the press. These men were so impressed with the information presented that they urged the War Department to relax restrictions and make the facts available to every war worker in the Nation. The film reveals the job that lies ahead for us, the problems and possibilities of attack on the Axis from the air, on land, and by sea. Interesting animated charts supplement dramatic action pictures in presenting strategic and statistical facts in a simple and engrossing manner. The strength of the enemy is revealed in his own film seized from him and now used to expose the truth about his men and equipment. A unique part of this seized footage gives the German's own film record of their abduction of Benito Mussolini. No one present at the convention can afford to miss this exceptional presentation. It is certain to be one of the highlights of the convention.

The general session on Monday afternoon will be devoted to a panel discussion of wartime controls applicable to the procurement of new equipment and maintenance, repairs, and operating supplies. Included on this panel will be Dr. Marcellus H. Stow, Deputy Director, and J. E. Bacon, Chief, Non-Metallic Section, both of the Mining Division of the War Production Board; the Building Materials Division will be represented by Roy Dagen, Chief, Concrete Materials Unit; and the Construction Machinery Division by M. B. Garber, Consultant to the Division and its former Director. A liberal amount of time will be available for questions from the floor. Here is an exceptional opportunity for members of the industry to obtain firsthand and authoritative information from government experts with respect to problems involving procurement of equipment and maintenance and operating supplies.

Simultaneous with this general session there will be a group meeting for the producers of agricultural limestone. Donald W. Aitken of the Division of Special Programs of the Agricultural Adjustment

Administration will talk on "The Program of the Agricultural Adjustment Adminstration for Stimulating the Use of Agricultural Limestone in 1944." Mr. Aitken will be followed by Dr. P. H. Groggins of the War Food Administration who will tell us about "Efforts Currently Being Made by the War Food Administration to Expedite the Production of Agricultural Limestone." The concluding speaker at this session will be Henry A. Huschke of the Fertilizers and Insecticides Branch of the Office of Price Administration, who will give us the very latest information on "Price Regulations Pertaining to the Sale of Agricultural Limestone." Following these three speakers time will be available for questions from the floor. It is especially suggested that those who may have had difficulty in understanding the price regulations pertaining to agricultural limestone bring such questions to the convention for answer by Mr. Huschke.

The Tuesday morning session will open with a paper entitled, "Developments in Railroad Roadbed Construction," presented by G. M. Magee, Research Engineer of the American Railway Engineering Association. Mr. Magee will be followed by a paper entitled, "Wartime Control of Wage and Salary Increases and Decreases," by R. S. Smethurst, Counsel for the National Association of Manufacturers. This subject is one of vital importance to every producer in the industry. A full understanding of the applicable rules and regulations is essential if severe penalties are to be avoided because of unintentional violations. Mr. Smethurst has made a special study of this problem and as Counsel for the NAM is preeminently qualified to give us the latest information. The Tuesday morning session will conclude with the report of the Nominating Committee and the election of officers and members of the Board of Directors.

The feature of the General Luncheon on Tuesday, sponsored by the Manufacturers' Division, will be a presentation, through the courtesy of the General Electric Company, of the "House of Magic." The "House of Magic" is a spectacular collection of mystifying demonstrations actually not "magic" at all, but proof that sober scientific fact can be stranger than fiction. Electricity, under the hands of the scientist, can really out-mystify magic and it does so in this demonstration. This show is currently being presented at various army and naval bases throughout the country. The very fortunate coincidence that it will be temporarily in New York during our convention period, enroute to its next booking, makes it possible for us to have it for our convention program.

On Tuesday afternoon there will be simultaneous group meetings for operating men and equipment manufacturers and for salesmen. Subjects for discussion at these two sessions have been selected with discriminating care and with especial regard to the practical problems confronting operating men and salesmen.

The Annual Banquet, the only evening event scheduled throughout the convention period, will be held on Tuesday evening, February 1. Following the presentation of the National Crushed Stone Association Safety Awards, Major George Fielding Eliot, the feature speaker on the program, will give us "An Analysis of the War Situation as of Today." Major Eliot, who is military analyst for the Columbia Broadcasting System and whose daily column on military events, syndicated by the New York Herald-Tribune, appears in some fifty-odd newspapers throughout the country, is preeminently qualified to give us an up-to-the-minute analysis of the war.

The Wednesday morning session will open with reports from the various convention committees, following which L. Metcalfe Walling, Administrator, Wage and Hour and Public Contracts Divisions of the United States Department of Labor, will discuss, "Application of the Walsh-Healey and Wage-Hour Acts to the Crushed Stone Industry." The importance of having accurate and authoritative information concerning the application of these two Federal statutes to our industry cannot be over-emphasized.

Mr. Walling will be followed by Dr. L. Don Leet, Associate Professor of Seismology at Harvard University, who will talk to us concerning "Modern Methods of Investigating Alleged Damage from Blasting." Always an important subject to the industry, growth of metropolitan areas in the proximity of quarry properties makes it most timely. Because of recent work in this field Dr. Leet's discussion should prove decidedly helpful and beneficial.

The concluding session of the convention on Wednesday afternoon will be devoted entirely to a discussion of problems involving the postwar highway program. It will open with a presentation by James J. Skelly, President of the Contractors' Division of the American Road Builders' Association, on "Shall We Win the War Without Winning the Peace?" Mr. C. H. Sells, Superintendent of Public Works of New

(Continued on page 18)

Rocks, Their History, Classification and Properties[1]

By D. G. RUNNER

Materials Engineer, Federal Works Agency
Public Roads Administration

Introduction

THE story of rock has its beginning millions of years ago. The earth as we now know it is one of a group of nine planets that revolve around a common center, the Sun. Some of these planets are smaller than the earth, and some like Jupiter, are much larger than the earth. There are a number of hypotheses regarding the origin of the earth. One of the most plausible explanations is found in the *planetesimal hypothesis* as expounded by Chamberlin[2]. He sets forth the theory that the earth has been gradually built up by the infall and accretion of relatively small solid bodies called "planetesimals." Through the enormous pressures exerted under the influence of gravity, contraction has ensued and gaseous matters have been expelled, giving rise to the atmosphere and surface waters. This contraction is thought to be the source of the interior heat; in the interior core where the contraction is greatest, the most heat develops and this flows outwardly to an intermediate zone. The latter is held to receive the heat faster from the interior than it loses it by conduction to the outer crustal zone; as a result melting ensues and the liquid material, by the forces to which it is subjected, works its way upward to the surface and, along with escaping gases, gives rise to volcanic activity.

The birth time of the earth was probably 2000 million years ago. However, its entire history is written in the rocks, and it is the task of geologists to decipher the complex developments throughout this period of geologic past.

Branches of Geology

The science of geology is rapidly coming into its own. Developments during the past 50 years have proved that it is more than a descriptive science. Geology and its various branches are studied in the field as well as in the laboratory and due to the use of modern instruments and methods, is a valuable aid to industrial and commercial undertakings. Because of its wide interest and development, the general science of geology has become specialized into numerous branches, the chief ones of which are given below:

(1) Physical geology—comprises the study of the existing form of the earth's surface, its structure, manner of origin and nature of modifying processes at work on it.

(2) Stratigraphy—deals with the formation, composition, sequence, and correlation of the stratified rocks as parts of the earth's crust.

(3) Historical geology—treats of the sequence of events which have occurred to the earth since its very beginning, with special reference to the development of life through the geological ages.

(4) Paleontology—is the science that deals with life in the geologic past, and is based upon the study of the fossil remains of organisms.

(5) Economic geology—refers to the location and development of metals and non-metals of economic importance to mankind. Examples are the precious metals, non-metals as oil and gas, coal, etc.

(6) Mineralogy—is the science dealing with crystal form, composition, physical properties, and the occurrence of minerals.

(7) Petrology—in the widest sense of the word refers to the relationships, composition and texture of rock bodies in the field.

(8) Petrography—is that branch of geology that treats of rocks as mineral aggregates and is studied in the laboratory by chemical and microscopical methods.

Geologic Time Table

Through long periods of study and research by paleontologists, the different strata of rock have, in general, been correlated throughout a large part of

[1] To be presented at a Short Course for Salesmen, National Crushed Stone Association, Washington, D. C., January 27, 28, 29, 1944.

[2] Text-Book of Geology, by Pirsson and Schuchert, Part I, Physical Geology, John Wiley & Sons, New York, N. Y.

the world, with the result that an orderly succession of rock bodies has been established. The comparison of rock strata has been accomplished by a study of the detailed nature of the rock types, their specific mineral composition, and by fossil content. This "time table" is divided into three main classes as follows: eras, systems, and series. The arrangement is as shown in table 1.

TABLE 1

GEOLOGIC TIME TABLE

Era	*Millions of years*	*System*	*Series*
Cenozoic (Age of mammals)	2 - 10	Quaternary	Recent, Pleistocene
		Tertiary	Pliocene, Miocene, Oligocene, Eocene
Mesozoic (Age of reptiles)	6 - 11	Cretaceous, Jurassic, Triassic	
Paleozoic (Ancient life)	12 - 46	Carboniferous	Permian, Pennsylvanian, Mississippian
		Devonian, Silurian, Ordovician, Cambrian	
Proterozoic (Primitive life)	27 +	Algonkian, Archean	
Total age	48 - 94		

As indicated, the eras are the main divisions and cover millions of years from the first development of the earth. The systems are the next smaller division, and are so named from important happenings in that particular period, or from some important geological development. For example, the carboniferous system was so named from the extensive development of the coal measures common to this geologic period. The cretaceous system was named from the chalk formations widely formed during this age.

Physiographic Provinces

Because of the topographic features, the United States has been divided into provinces that feature certain geologic developments. In these provinces are found a great diversity of material. For example, New England is very rugged and has a plentiful supply of marble, granite, trap, slate, etc. The Appalachian province has not only igneous rocks in abundance but such metamorphic rocks as gneisses, schists, marble, quartzite, etc. The coastal plain region, in contrast with other areas in the United States has relatively few rocks exposed at the surface. The interior lowlands, with the exception of the Ozark Plateau and the Ouachita Mountains, contain an abundance of sedimentary rocks such as shales, limestones, and sandstones. In the west in the Colorado Plateau and Rocky Mountains there is an almost unlimited supply of igneous rocks such as granites, basalts, rhyolites, diabases, etc., together with boundless resources of the metallic materials.

Composition of the Earth's Crust

The land upon which we live is considered by geologists as the "crust" of the earth. In other words the solid portion both above and below sea level is considered as floating upon a semi-rigid molten mass. The interior of this earth is extremely hot; much hotter than it is possible to imagine. One estimate is 20,000° C. as the possible temperature. It is a well known fact that the temperature gradient is about 1 degree C. per 100 feet of depth. The greatest depth to which man has drilled with present day equipment has been around 10,000 feet. Data from these measurements as well as from the magma emitted from volcanoes have provided information relative to composition, temperature, density of the earth and other pertinent facts. The mean density of the earth as a whole is estimated to be about 5.52, whereas that of the crust is about 2.80 to 3.00. Certain assumptions make the estimate of the density of the molten interior of the earth to be around 10.00.

Enough data have been accumulated during the past half-century to establish average values for the composition of the earth's crust. By this crust is meant the solid portion 10 miles in thickness, together with the hydrosphere, and the atmosphere. These data are shown in table 2.

TABLE 2

COMPOSITION OF THE EARTH'S CRUST.

10-mile crust (lithosphere, or solid portion)	93.00%
Hydrosphere (water portion)	7.00
Atmosphere	0.03

Lithosphere (solid portion of crust) is composed of:

Igneous rocks	95%
Shale	4
Sandstone	0.75
Limestone	0.25

NOTE: Metamorphic rocks, such as gneisses and schists are included in the igneous group.

Here it may be seen that the solid portion constitutes by far the greatest part of the earth on which we live. Leaving the hydrosphere and the atmosphere out of the picture, we come to the estimated percentage composition of the solid crust. Evidently the igneous rocks constitute the greatest part of the earth as we know it.

It may be of interest here to show the average chemical analyses of the igneous rocks composing the outer shell or crust. These data are given in table 3.

TABLE 3
AVERAGE COMPOSITION OF THE IGNEOUS ROCKS.

Oxides	*Percent*
SiO_2 (Silicon)	59.12
Al_2O_3 (Aluminum)	15.34
Fe_2O_3 (Iron)	3.08
FeO (Iron)	3.80
MgO (Magnesium)	3.49
CaO (Calcium)	5.08
Na_2O (Sodium)	3.84
K_2O (Potassium)	3.13
H_2O (Water)	1.15
TiO_2 (Titanium)	1.05
P_2O_5 (Phosphorus)	0.30
MnO (Manganese)	0.12
Balance	0.50
Total	100.00

These figures are based on analyses of rocks from all parts of the world and represent approximately 6,000 separate sets of analyses. It is interesting to note that of the 90 odd chemical elements known today, about eight are very prominent in the analyses shown.

Source of Rocks

All rocks have originated from the molten mass in the center of the earth. This magma, or molten rock is a mutual solution of complex silicates with some oxides and sulphides, together with water and other gases held in solution by pressure; by some geologists, heat is considered to be the main factor in its liquidity. Regarding the initial source of heat and of the magma, we will have to accept the hypothesis set forth by Chamberlin. The heat is thought to have been derived from the nucleus of the gaseous globe and planets. Suffice it to say that the core of the earth is a hot, viscous silicate mass confined by the hardened outer shell or crust. This rock magma is discharged from volcanoes and vents in the earth's crust, especially so in regions of mountain building such as occurred in the western coast of North America to the southern tip of South America.

Order of Crystallization in Igneous Rocks

It has been postulated that there is a definite order of crystallization from the magma. Geophysicists have determined from working with artificial melts that there is a more or less fixed plan of rock hardening. Starting with the "parent" magma, by physicochemical laws, the ores congeal and settle out first. Next the olivine or ferro-magnesian minerals and basic plagioclase feldspars emerge. As the reaction continues, the magma becomes less basic and more silicic in composition until finally the very acid rocks (those high in silica) such as the granites and rhyolites are formed. Lastly, hydrothermal water and gases are released. From these igneous rocks, the metamorphic and sedimentary rocks are formed, the metamorphic rocks by pressure and heat, the sedimentary rocks by consolidation of rock debris produced by the weathering of existing rocks.

Rock Classification

According to their mode of origin and composition rocks naturally divide themselves into three great classes. This grouping is shown in table 4, together with the origin of the word for each group.

TABLE 4
GROUPING OF ROCKS FOR CLASSIFICATION PURPOSES.
All Rocks

Group No.	*Name*	*Origin of name*
I	Igneous	Latin word IGNIS = fire
II	Sedimentary	Latin word SEDIMENTUM = settling.
III	Metamorphic	Greek Words META = over MORPHE = form

Group I includes the rocks solidified from molten material, and may be considered as the "parent" of the two remaining groups. Group II rocks have been formed by the deposition of sediments in water, to which may be added the small groups of wind-formed (loess) and ice-formed (till) deposits. Finally we have group III rocks or those formed by the action of heat and pressure on igneous or sedimentary rocks. Rocks must of necessity be classified in order to place them in their natural relations so

TABLE 5

CLASSIFICATION OF THE IGNEOUS ROCKS

← Acid rocks, light colored — Basic rocks, dark colored →

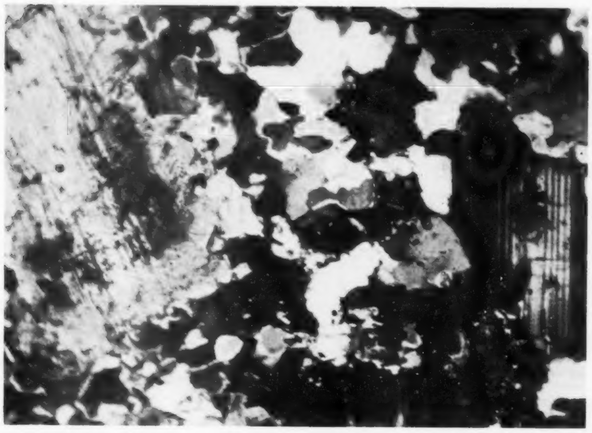
Potash feldspar		Lime-soda feldspar				Texture
±Bioite ±Hornblende ±Augite		Biotite and/or hornblende		Pyroxene		
+Quartz	−Quartz	+Quartz	−Quartz	−Olivine	+Olivine	
GRANITE	SYENITE	QUARTZ-DIORITE	DIORITE	GABBRO	OLIVINE-GABBRO	Coarse-grained
	GRANODIORITE					
GRANITE-PORPHYRY	SYENITE-PORPHYRY		DIABASE			Porphyritic
RHYOLITE	TRACHYTE	DACITE	ANDESITE	AUGITE-ANDESITE	OLIVINE-BASALT	Fine-grained
			BASALT			
OBSIDIAN PUMICE						Glassy, Frothy
ASH, TUFF, BRECCIA						Fragmental

TABLE 6

CLASSIFICATION OF THE SEDIMENTARY ROCKS.

Origin	*Formed by*	*Major Class*	*Subdivisions*	*Remarks*
Mechanical	Water-action	Conglomerate		Rounded pieces
		Sandstone	Argillaceous sandstone	Clay binder
			Calcareous sandstone	Limey binder
			Feldspathic sandstone	Excess feldspar
			Ferruginous sandstone	Iron binder
		Arkose		
		Shale	Calcereous shale	Lime-bearing
			Siliceous shale	Sandy
	Wind-action	Loess		
Chemical	Solution and/or organic agencies	Chert (Flint)		
		Limestone	Argillaceous limestone	Excess clay
			Bituminous limestone	
			Dolomitic limestone	Excess magnesia
			Ferruginous limestone	Contains iron
			Siliceous limestone	Sandy
			Limerock	
		Dolomite	Argillaceous dolomite	Clayey
			Siliceous dolomite	Sandy

far as possible and also to allow of their systematic study. They must be grouped on the basis of texture, mineralogical composition, or their manner of formation. In the case of group I, the feldspars form the major basis for the systematic classification, together with the rock texture and field occurrence.



Photomicrograph of Hornblende-Biotite Granite Illustrating the Granular and Interlocking Structure of the Minerals in This Type of Rock. 32X

The generalized classification for the igneous or group I rocks is indicated in table 5.

In contrast to the manner of formation of the rocks in group I, the rocks in the group II class have been formed by two major methods—mechanical and chemical origin. Reference to table 6 brings out the relationship between the two modes of formation. In this group, texture, composition and size of the individual fragments, play an important role in the classification. This is especially true for the water and wind deposits.

In group III, we again have two major processes by which metamorphic rocks are formed. One is by contact metamorphism where the heat from igneous bodies has changed the original rock into material of a different character. This process is usually confined to relatively small areas, such as found near sills, dikes, and the areas adjoining large bodies of igneous rocks. In contrast to these more or less localized areas, we have rocks produced by regional pressure, covering large areas of land. This is particularly true in regions of mountain building where heavy pressures have been built up by crustal movements, and by subsidence and elevation of the

TABLE 7

CLASSIFICATION OF THE METAMORPHIC ROCKS

Origin	*Major Class*	*Subdivision*	*Texture*
Contact metamorphism (Chiefly by heat)	Quartzite	Feldspathic quartzite	Granular
		Micaceous quartzite	Granular
Regional metamorphism (Chiefly by pressure)	Gneiss	Hornblende gneiss	Banded
		Mica gneiss	"
		Granite gneiss	"
		Quartz gneiss	"
		Biotite gneiss	"
	Schist	Hornblende schist	Foliated
		Biotite schist	"
		Sericite schist	"
		Mica schist	"
		Talc schist	"
	Slate	Calcareous slate	Fissile, fine-grained
		Siliceous slate	" "
	Marble	Dolomitic marble	Crystalline
	Amphibolite		Crystalline
	Serpentine		Fine-grained

TABLE 8

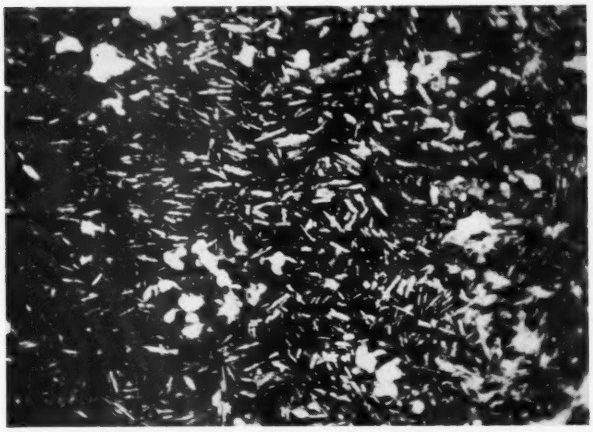
AVERAGE PERCENTAGE MINERALOGICAL COMPOSITION

	Quartz	Orthoclase	Plagioclase	Augite	Hornblende	Biotite	Muscovite	Epidote	Rock glass
			IGNEOUS ROCKS						
Granite	30	41	8	—	—	3	3	1	—
Diorite	8	7	30	3	27	4	0.1	5	—
Gabbro	0.5	—	44	28	9	2	—	1	—
Diabase	—	—	44	46	—	—	—	—	2
Rhyolite	32	45	3	—	0.7	3	2	2	0.4
Trachyte	3	42	1	2	6	0.5	—	8	9
Andesite	0.6	—	48	14	3	—	—	3	13
Basalt	—	—	36	35	—	—	—	—	21
			METAMORHPIC ROCKS						
Quartzite	84	3	—	—	1	2	2	2	—
Feldspathic-quartzite	46	27	1	—	—	2	5	1	—
Hornblende-gneiss	10	16	15	3	45	3	1	2	—
Granite-gneiss	37	32	3	—	—	7	11	2	—
Biotite-schist	34	13	3	—	1	38	3	2	—
Mica-schist	37	16	1	—	—	13	26	2	—
Slate	29	4	—	—	—	—	55	2	—
Marble	3	0.2	0.2	—	—	—	Calcite = 96		—
Amphibolite	3	1	8	—	70	1	0.2	12	—
			SEDIMENTARY ROCKS						
Sandstone	79	5	0.3	—	—	0.2	1	—	—
Feldspathic-sandstone	35	26	2	—	—	0.6	2	1	—
Calcareous-sandstone	46	3	2	—	—	—	Calcite = 42		—
Chert	93	—	—	—	—	—	Calcite = 1		—
Limestone	6	—	—	—	Dolomite = 8		Calcite = 83		—
Dolomite	5	—	—	—	Dolomite = 82		Calcite—11		—

TABLE 9

TYPICAL PERCENTAGE CHEMICAL ANALYSES OF IGNEOUS ROCKS.

Rock	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O
Granite	68.3	14.8	1.3	2.7	0.8	2.3	2.7	5.0	1.1
Syenite	64.7	10.5	1.1	7.4	5.2	3.1	2.2	3.6	0.9
Granodiorite	59.9	16.4	3.0	3.7	3.1	6.3	4.1	2.5	1.1
Quartz-diorite	46.5	13.3	2.6	7.2	7.3	8.2	1.7	1.7	3.7
Diorite	52.1	16.4	3.7	6.0	4.1	7.3	3.7	2.3	1.1
Gabbro	44.9	15.4	2.3	12.4	10.9	7.5	3.0	0.5	0.8
Olivine gabbro	49.8	18.6	2.1	8.4	5.8	9.7	2.6	0.7	1.0
Granite porphyry	73.5	13.7	1.2	0.7	0.4	1.2	4.4	4.5	0.4
Syenite porphyry	64.5	16.8	2.1	1.0	0.6	1.4	6.1	5.7	0.8
Diabase	48.9	20.9	2.0	9.4	4.4	8.0	3.1	1.8	1.2
Rhyolite	74.3	12.9	0.8	0.5	0.9	0.9	2.5	4.7	2.1
Trachyte	66.0	18.5	2.2	0.2	0.4	1.0	5.2	5.9	0.9
Dacite	65.7	15.6	2.1	2.1	2.5	3.6	3.7	2.0	1.1
Andesite	61.4	16.6	2.1	3.1	2.7	6.2	3.8	1.3	1.7
Augite-andesite	63.5	12.4	6.4	1.3	1.3	4.2	4.9	1.8	2.9
Basalt	51.7	17.9	7.2	1.0	2.8	6.9	4.2	1.6	1.2
Olivine basalt	49.9	15.2	1.7	10.5	6.3	9.4	3.1	0.9	0.2
Obsidian	73.5	12.9	0.4	0.4	0.2	0.6	4.4	4.3	3.5
Pumice	68.6	14.2	1.4	1.5	0.8	2.4	5.2	2.5	3.3
Ash	64.5	14.7	2.7	0.8	0.3	4.0	2.6	3.3	5.7
Tuff	31.4	11.6	2.4	7.5	5.3	16.7	2.3	0.7	4.9
Breccia	46.7	12.8	0.5	—	2.6	5.4	3.7	6.9	1.2



PHOTOMICROGRAPH OF BASALT (OR TRAP) ILLUSTRATING THE DENSE CHARACTERISTIC OF ROCK OF THIS TYPE. 32X

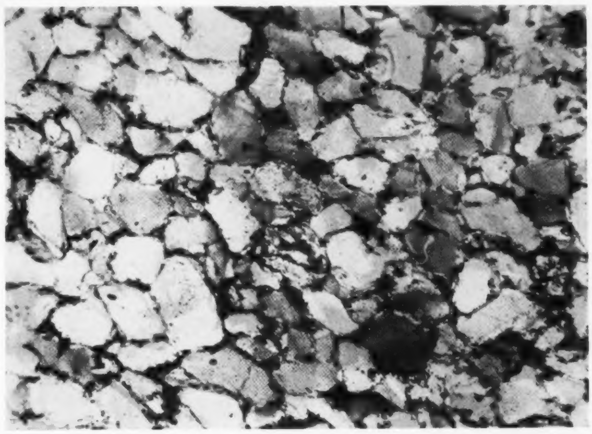
land. These processes covering long periods of time, have produced such rock types as are shown in table 7.

Diagnostic Features of Rocks

There are several criteria for distinguishing between the igneous, metamorphic, and sedimentary rocks. Some of these more important features are shown below:

Igneous rocks: Interlocking grains, mostly hard rocks; texture such as glassy, frothy, cellular, etc.; high in feldspar content; no fossils; normal order of crystallization.

Sedimentary rocks: Stratification, mostly soft rocks; rounded and fragmental pieces; presence of fossils; minerals of the chemical precipitates; fine-grained texture, especially in the case of limestone, sandstones, and shales.



PHOTOMICROGRAPH OF SANDSTONE, SHOWING THE ROUNDED MINERAL GRAINS CEMENTED WITH AN IRON-BEARING MEDIUM. 30X

TABLE 10

TYPICAL PERCENTAGE CHEMICAL ANALYSES OF THE SEDIMENTARY ROCKS

Rock	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	CO_2	H_2O
Conglomerate	59.2	19.2	Tr.	6.5	2.5	1.1	1.6	5.4	—	2.2
Sandstone	76.1	8.7	—	3.5	4.3	1.3	1.1	0.5	—	1.7
Argillaceous-sandstone	75.5	14.8	6.4		—	—	—	—	—	2.0
Calcareous-sandstone	54.2	7.4	0.5	1.4	3.3	14.6	1.7	1.7	—	1.5
Feldspathic-sandstone	—	—	—	—	—	—	—	—	—	—
Ferruginous-sandstone	49.8	5.2	29.2	0.4	1.0	2.4	0.8	0.5	—	10.4
Arkose	76.1	8.7	—	3.5	4.3	1.3	1.1	0.5	—	1.7
Shale	53.3	22.4	6.6		2.1	0.5	1.1	7.4	—	4.1
Calcareous shale	37.9	7.0	1.0	0.5	12.4	13.3	1.2	2.0	—	1.7
Siliceous shale	82.7	1.8	1.0	0.3	1.1	2.9	0.5	2.6	—	4.8
Chert	98.2	0.8		—	—	—	—	—	—	—
Limestone	3.8	1.0	0.4	—	1.2	51.3	—	—	41.6	—
Argillaceous-limestone	17.0	6.9	2.1	—	2.2	35.5	—	—	32.9	—
Dolomitic-limestone	16.2	3.2	0.9	—	$MgCO_3$=36.0		$CaCO_3$=54.5			—
Ferruginous-limestone	28.8	1.3	1.0	37.4	3.6	0.7	—	—	—	0.7
Siliceous-limestone	27.5	1.7	2.0	—	$MgCO_3$= 0.3		$CaCO_3$=63.8			1.9
Limerock	0.3	0.3		—	$MgCO_3$= 0.4		$CaCO_3$=99.0			—
Dolomite	0.1	0.1	—	0.3	21.2	30.6	—	—	46.9	0.2
Argillaceous-dolomite	2.4	—	1.3	—	$MgCO_3$=41.1		$CaCO_3$=51.1			—
Siliceous-dolomite	8.3	1.8	0.2	1.1	16.7	29.0	0.1	1.1	41.6	0.4

TABLE 11

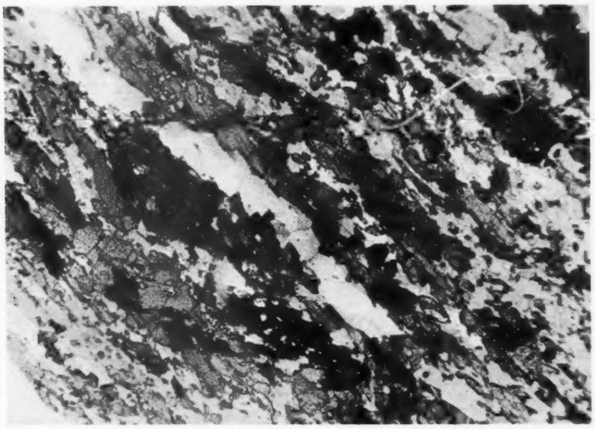
TYPICAL PERCENTAGE CHEMICAL ANALYSES OF METAMORPHIC ROCKS

Rock	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O
Quartzite	74.2	10.6	7.5	0.9	1.5	0.6	2.1	1.1	1.8
Feldspathic quartzite	73.7	11.1	7.2	0.8	1.5	0.4	1.7	1.7	—
Micaceous quartzite	—	—	—	—	—	—	—	—	—
Gneiss	70.2	13.9	1.1	3.1	1.3	3.1	3.3	2.7	0.7
Hornblende gneiss	48.7	14.4	4.0	10.1	6.3	9.2	2.3	0.5	2.5
Granite gneiss	66.9	14.9	0.9	3.4	0.3	1.2	5.6	5.0	0.5
Quartz gneiss	76.9	12.1	1.2	1.4	1.9	0.4	5.3	Tr.	0.5
Biotite gneiss	67.7	16.6	2.1	2.0	1.3	1.9	4.4	2.4	1.7
Mica gneiss	58.8	17.2	5.2	4.0	0.9	0.6	5.7	5.4	1.1
Schist	59.3	19.5	1.8	5.7	1.8	1.2	1.3	3.3	4.2
Hornblende schist	50.3	14.1	7.0	5.3	7.2	8.1	4.0	2.3	1.6
Biotite schist	62.4	17.4	1.0	7.1	2.1	0.5	0.7	4.1	3.1
Sericite schist	57.2	23.5	3.2	4.9	0.9	0.1	1.2	3.6	5.0
Mica schist	64.7	16.3	1.8	3.8	2.9	0.1	0.1	5.6	3.1
Talc schist	53.3	4.4	5.8	1.0	29.9	1.5	1.5		2.6
Slate	61.6	16.3	4.1	2.7	2.9	0.5	1.3	5.5	3.4
Calcareous slate	50.9	14.1	—	9.9	8.7	8.7	—	0.9	—
Siliceous slate	78.9	None	13.9	1.2	0.2	0.8	—	—	2.9
Marble	—	0.2		—	21.4	30.9	CO_2=46.7		
Dolomitic marble	—	—	0.2	—	20.7	30.7	CO_2=46.7		
Amphibolite	48.5	16.4	2.0	10.5	9.7	9.8	1.4	0.3	0.8
Serpentine	40.0	1.4	—	3.4	39.2	—	—	—	12.1

TABLE 12

PHYSICAL PROPERTIES OF IGNEOUS ROCKS

Rock type	Specific gravity	Compressive Strength, lb./sq. in.	Weight per cu. ft. lbs.	Absorption percent	Toughness	Abrasion Tests: Los Angeles	Abrasion Tests: Deval
Granite	2.63	25,000	164	0.30	9	41.5	4.7
Syenite	2.71	26,900	169	0.44	14	38.8	4.0
Granodiorite	2.72	—	170	0.20	9	31.3	5.4
Diorite	2.87	10,000	179	0.23	17	—	3.1
Gabbro	2.93	41,800	183	0.21	14	14.0	3.4
Olivine gabbro	—	—	—	—	—	—	4.7
Granite porphyry	2.64	45,000	165	0.53	15	32.7	4.3
Syenite porphyry	2.61	—	163	0.58	10	—	3.1
Diabase	2.97	31,500	185	0.20	20	15.3	2.3
Rhyolite	2.61	39,000	163	0.58	18	16.4	3.6
Trachyte	2.66	25,000	166	0.99	18	20.7	4.2
Andesite	2.63	17,000	164	0.93	18	—	3.7
Augite-andesite	2.71	—	169	0.78	15	32.5	3.9
Basalt	2.84	47,000	177	0.42	30	16.7	3.0
Olivine basalt	2.79	51,000	174	0.79	19	9.2	4.0
Ash	—	—	—	—	23	—	2.8
Tuff	—	—	—	—	10	—	8.7
Breccia	2.55	—	159	2.14	11	—	7.6



PHOTOMICROGRAPH OF SCHIST, ILLUSTRATING THE PARALLELISM OF THE MINERALS. THIS SCHISTOSITY IS CHARACTERISTIC OF THE ROCKS OF THE SCHIST TYPE. 30X

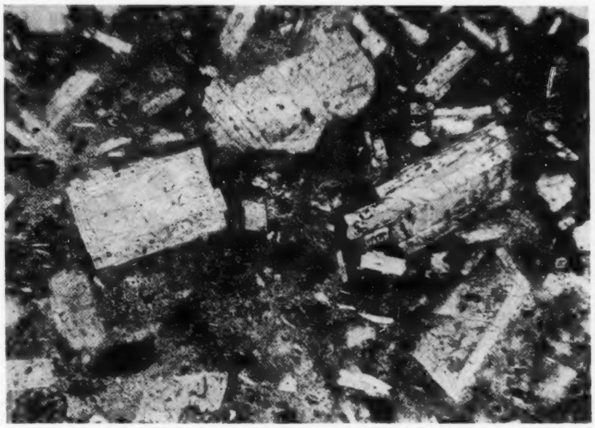
Metamorphic rocks: Parallelism of mineral grains producing banding; interlocking grains, hard rocks; foliation; schistosity; distorted pebbles and crystals; characterstic metamorphic minerals such as garnet, kyanite, etc.

Average Mineral, Chemical and Physical Properties

From the results obtained in examining hundreds of rocks, the average percentage mineral composition of the chief rock types in each group is presented in table 8.

The average percentage chemical composition of the various rocks in the three groups is indicated in tables 9, 10, 11.

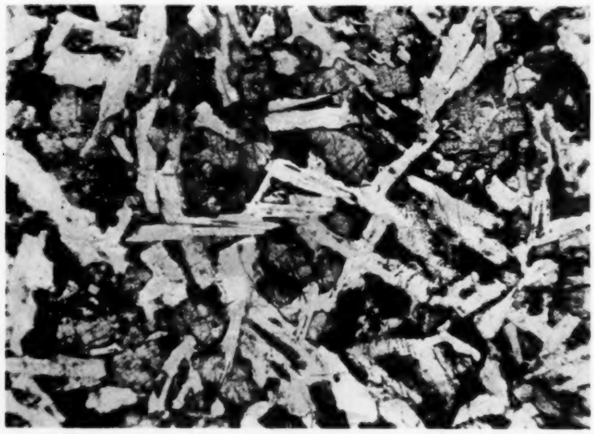
As in the case of the mineral and chemical composition, the physical properties of rock vary somewhat. These variables can be traced to differences in texture, manner of formation, and mineralogical composition. In order to determine whether or not



PHOTOMICROGRAPH OF ANDESITE, SHOWING THE LARGE MINERAL CRYSTALS EMBEDDED IN A FINER GROUNDMASS. 30X

TABLE 13
PHYSICAL PROPERTIES OF SEDIMENTARY ROCKS

Rock type	Specific gravity	Compressive Strength, lb./sq. in.	Weight per cu. ft. lbs.	Absorption percent	Toughness	Abrasion Tests: Los Angeles	Abrasion Tests: Deval
Conglomerate	2.64	20,000	165	——	10	——	——
Sandstone	2.44	22,900	152	1.66	12	58.7	5.4
Argillaceous sandstone	2.48	———	155	4.12	13	21.5	7.1
Calcareous sandstone	2.61	23,400	163	1.45	12	——	6.6
Feldspathic sandstone	2.52	20,250	157	1.30	12	22.8	4.8
Ferruginous sandstone	2.61	19,800	163	1.74	11	——	13.5
Shale	2.52	———	157	1.57	3	——	11.4
Calcareous shale	2.66	———	166	1.05	8	——	8.1
Siliceous shale	2.64	———	165	——	—	——	4.7
Chert	2.47	———	154	1.42	12	26.4	9.5
Limestone	2.63	17,500	164	0.61	8	33.8	5.6
Argillaceous limestone	2.64	21,800	165	1.51	8	27.4	6.2
Bituminous limestone	2.32	———	145	1.23	6	——	4.1
Dolomitic limestone	2.68	———	167	0.93	9	——	4.6
Ferruginous limestone	2.57	22,600	160	1.48	6	——	7.5
Siliceous limestone	2.64	24,350	165	1.13	9	23.7	5.7
Limerock	2.57	———	160	1.60	5	36.3	17.4
Dolomite	2.71	21,200	169	1.09	8	27.1	5.9
Argillaceous dolomite	2.63	20,500	164	1.85	6	27.2	5.8
Siliceous dolomite	2.71	33,200	169	1.11	11	32.5	5.0



PHOTOMICROGRAPH OF DIABASE, SHOWING THE INTERLOCKING STRUCTURE OF MINERAL CRYSTALS. 30X

a given sample of rock is suitable for a certain purpose, it is customary to subject the rock to such tests as specific gravity, absorption, percent of wear, toughness, etc. This is particularly true if the material is proposed for use in highway construction. Typical values obtained by physical testing are presented in tables 12, 13, and 14.

Suggested Reading

Should the reader be interested in delving further into this field, there are a number of excellent references on geology, mineralogy, rocks, engineering geology and related subjects. A few of these are listed below.

1. J. F. Kemp, Handbook of Rocks, D. Van Nostrand Co., New York.
2. F. H. Lahee, Field Geology, McGraw-Hill Book Co., New York.
3. Pirsson and Knopf, Rocks and Rock Minerals, John Wiley and Sons, New York.
4. E. C. Eckel, Building Stones and Clays, John Wiley and Sons, New York.
5. G. L. English, Getting Acquainted with Minerals, McGraw-Hill Book Co., New York.
6. F. B. Loomis, Field Book of Common Rocks, G. P. Putnams Sons, New York.
7. D. G. Runner, Geology for Civil Engineers, Gillette Publishing Co., Chicago, Ill.
8. O. Bowles, The Stone Industries, McGraw-Hill Book Co., New York.

TABLE 14

PHYSICAL PROPERTIES OF METAMORPHIC ROCKS

Rock type	Specific gravity	Compressive Strength, lb./sq. in.	Weight per cu. ft. lbs.	Absorption percent	Toughness	Abrasion Tests	
						Los Angeles	Deval
Quartzite	2.71	31,000	169	0.24	19	26.1	3.6
Feldspathic quartzite	2.68	23,000	167	0.24	19	30.3	3.0
Micaceous quartzite	2.71	26,280	169	0.38	13	28.5	3.9
Gneiss	2.76	——	172	0.21	10	——	4.4
Hornblende gneiss	2.94	17,300	183	0.21	10	66.4	4.8
Granite gneiss	2.68	23,900	167	0.25	8	41.1	4.3
Quartz gneiss	2.85	——	178	0.10	9	32.1	3.6
Biotite gneiss	2.72	20,300	170	0.29	8	41.1	5.4
Mica gneiss	2.72	——	170	0.29	9	55.9	4.7
Schist	2.77	——	173	0.30	32	——	4.7
Hornblende schist	3.00	——	187	0.19	17	46.2	3.5
Biotite schist	2.74	——	171	0.26	9	36.5	5.0
Sericite schist	2.76	——	172	0.31	9	37.5	7.9
Mica schist	2.72	——	170	0.31	9	45.9	5.0
Talc schist	2.93	——	183	0.34	6	——	8.2
Slate	2.74	21,800	171	0.36	18	——	4.4
Calcareous slate	2.64	35,000	165	0.59	12	——	6.7
Siliceous slate	2.72	25,700	170	0.35	21	16.4	4.0
Marble	2.71	13,600	169	0.21	5	54.2	6.8
Dolomite marble	2.80	28,900	175	0.25	6	42.1	5.0
Amphibolite	3.03	34,300	189	0.30	15	33.2	3.6
Serpentine	2.63	43,000	164	0.74	13	18.5	7.1

Public Policy on Construction[1]

By ERIC A. JOHNSTON

President, Chamber of Commerce of the United States

THE National Chamber comes into daily contact with construction activities through our fourteen hundred chamber of commerce members located in every state in the Union. These chambers of commerce are vitally concerned with problems of civic development in their communities and hence with the problems of construction, both private and public. In addition, the National Chamber has direct contacts with the construction industry through our trade association members, who represent the manufacturers and distributors of building materials and equipment, the various contracting organizations who build and equip the structures, and mortgage and banking institutions who finance them. Construction is a highly localized industry. It contains thousands of small business concerns whose organizations are well represented in the Chamber's membership.

It seems to us in the Chamber that you are undertaking a most important and timely inquiry which should help Congress and also the construction industry and our communities in their consideration of just what the role of construction is in our economy, and in that connection what the role of public works is or should be. It is my understanding that you are going to call upon various sections of the construction industry as well as other sections of our economy, governmental and private, including representatives of the states and municipalities, with a view to getting a well-rounded picture. That is encouraging. You may be sure that the National Chamber will be helpful to you in every possible way.

What I want to discuss with you today is the urgent need for a public policy on construction. Prompt action is necessary to encourage the immediate blueprinting of both private and public work, so that there will be ready a large volume of useful work when materials and labor become available.

I hope that Congress can find means to make it clear to the country

1. That Congress looks to the construction industry to eliminate its own peaks and valleys as far as possible and in that way to make its contribution to providing useful employment, and does not expect that industry to stabilize our whole economy.
2. That Congress expects the city, county and state governments to finance their own ordinary local public works, such as water systems, street improvements, educational buildings and recreational facilities.
3. That the federal government will correlate its own proper public works expenditures through a suitable agency, in order that there may be certainty in regard to what the federal government is going to do, and elimination of wasteful expenditures.
4. That the federal government's public works will be undertaken through the contract method of public construction.
5. That the federal government will not undertake any activities in the field of housing which will compete with private builders or interfere with the community's responsibility for the enforcement of minimum housing standards and the relief of needy families.

In order to make such a public policy on construction realistic, the government should make suitable changes in our tax laws to encourage private investment and to enable business concerns to resume promptly deferred maintenance work and to reconvert speedily from wartime to peacetime operations.

In addition Congress should initiate at once the necessary inquiries, looking to a revision of our tax structure, which will make available additional sources of revenue for state and local governmental use, and thus free these local governmental agencies from their dependence upon the federal government.

I am confident that if Congress would establish a policy and take active steps in these directions it would serve as a powerful stimulus to private business and also to communities and states in the preparations they are making for useful construction work as soon as the materials and labor become available.

[1] A statement to the Lanham Committee, December 1, 1943.

Some of this work, which is badly needed, may be able to go forward before the end of the war. If so that will be all to the good. It will take up any employment slack which may occur as the war passes from one phase to another, and workers and materials become available. In addition it will keep the construction industry, which is now on a minimum basis of operation, sufficiently organized to take up promptly its share of providing peacetime employment when the war is over.

In amplifying this statement I want to stress to the Committee at the outset that there are limits to what construction, private and public, can do in providing employment. It has an important contribution to make to an active economy. In my judgment, however, construction can not be expected to provide more than around 10 to 15 per cent of the total income and employment. The remainder of income and employment must come from other sectors of the economy.

Neither management nor labor, as I sense their feeling, relish the idea of the industry being used in some theoretical way to stabilize the whole economy. Such efforts too quickly degenerate into pyramid building with economy and utility of work taking a secondary position. The construction industry's job is to stabilize itself. Its leaders feel that if measures can be worked out so that construction itself can provide more steady employment in its own proper field of activity it will have made a substantial contribution to the whole economy.

It is important to keep in mind that public works are the smaller part of construction activity. Therefore measures to encourage private construction must be a part of a forward looking public policy. In the twenties when total new construction activity ran up to an annual volume of ten billion or more, all public construction, city, county, state and federal accounted for one-third or less of the total. The other two-thirds was private construction of factories, commercial buildings, and housing.

In the latter part of the thirties three-fifths of construction was private work.

During the war all of this was changed. Nearly 80 per cent of the total new construction volume, which rose to the high level of thirteen and a half billion in 1942, was publicly financed. This was due to the war construction program, consisting of cantonments and other military establishments, war plants and war housing.

At the present time the construction industry faces a critical period. The unparalleled war construction program is tapering off while civilian construction, both public and private, much of it badly needed, is severely curtailed in order to divert both materials and manpower to the war effort. It may be possible to permit additional civilian construction as the war passes into different phases and labor and materials become available. This would be helpful. Just how much can be done in this connection is a matter for determination by the responsible officials in the War Production Board in cooperation with the industry. I know that the problem is receiving careful consideration.

Recently I received a letter which expresses what many civic leaders are thinking, from the President of a chamber of commerce in New Jersey. He writes:

"Our committee for coordinating and developing postwar plans is running into the question of financing public works developments after the war. The thought expressed by the politically minded is that there will be federal funds available—why not get our share.

"I am writing you to get your thoughts in regard to the localizing of necessary financing and to find out what is being done to limit federal extravagance in that respect after the war.

"If large amounts of money are going to be made available for the asking, our city and county want to have their plea in first, but it is my hope that something is being done to persuade the government to finance only proper governmental projects."

This civic leader wants to know what our thinking is concerning the federal financing of ordinary local public works, such as water supply, sewage disposal, street improvements, recreational facilities, and educational and institutional buildings. I should like to see ourselves in a position to tell him and the presidents of our other fourteen hundred chamber of commerce members that the Congress is looking to the states and communities themselves to assume this responsibility. The federal government will have all it can do to finance the demobilization of the military forces, and to help finance the feeding and indispensable rehabilitation of the peoples in the vast areas devastated by war. In addition it must finance its own proper public works activities, such as highways, federal buildings, and reclamation projects.

The states and communities in contrast to the federal government are in a better financial condition than they have been in a decade. In the State of New Jersey, for example, all but ten of the 566 municipali-

ties are operating on a cash, or "pay-as-you-go" basis in relation to current expenditures. Current tax collections are the best on record. There are strong state laws which regulate local budgeting, financial reporting, borowing and expenditures control. We are reliably informed that the great majority of municipalities in this state are able not only to defray the cost of whatever planning they might do, but also to finance the construction, within reason, of projects set forth in such plans.

In the period from 1925 to 1930 cities, counties and states financed each year a public works program of around two and a half billion dollars. Why should we not expect them to be in a position to finance a comparable program of needed public construction after this war?

They will certainly be able to do so if we have business prosperity which can and will provide both the inducement and the necessary taxes. Therefore we must clear the way for private industry to do its job of providing employment and income. We must at once give serious attention to revamping our tax structure so as to encourage private investment and so as to release for the use of the states and local governments sources of taxes which they must have to make themselves financially independent of the federal government.

Certainly now is the time for the states and communities to take on, and to be placed in a position to take on, every responsibility they can. They should relieve the federal government of every possible obligation in connection with the difficult problems of adjusting our economy to peactime operations. Among other important measures they should blueprint their own public works now and should take the necessary steps now to be in a position to finance them when materials and labor become available.

Many communities are setting aside reserves to finance deferred public construction and maintenance work. More of this can be done and should be encouraged. Through proper changes in the tax laws, Congress can encourage private concerns to resume promptly deferred maintenance work and to prepare now to carry through industrial and other construction work which must be part and parcel of our return to peacetime production and employment.

Private home builders will go forward with their plans more promptly for work after the war if they are assured by suitable action on the part of Congress that the government-financed housing program, which has of necessity been carried on so extensively as a war measure, will be discontinued at the end of the war, that suitable disposition of the temporary housing will be made and that the government will not undertake any activities in the field of housing which will compete with private builders or interfere with the community's responsibility for the enforcement of minimum housing standards and the relief of the needy.

The federal government on its part should correlate its own public works expenditures. At present there is no sufficiently authoritative agency for giving consideration to the combined benefits and costs of proposed federal expenditures for public works. Congress might very well set up a suitable agency for this purpose.

In addition the federal government can set an example to the states and localities by general adoption of the contract method of public construction. Experience has demonstrated that to secure better performance in shorter time and at lower cost, public construction should be carried out through competitive contracts with private construction enterprise and not through hiring day labor or resorting to work-relief methods.

Now is the time for action. I am confident that Congress can help the courageous and progressive civic leadership which is coming to the front in all parts of our country by a declaration of constructive policy with respect to construction. Such a declaration based on all the facts and a careful appraisal of our past experiences can be an important factor in our whole future economic activity.

Use of Liming Materials Increases

TOTAL consumption of all kinds of liming materials has increased tenfold in the past 10 years and practically all of the increase is due to increased consumption of ground limestone. Total consumption dropped from 3,736,000 tons in 1929 to 1,627,000 tons in 1933; rose to 7.047,000 tons in 1938, then climbed rapidly to 17,885,000 tons in 1942.

The first AAA benefit payments to farmers for use of lime were made in 1936, and consumption that year increased 3,000,000 tons over 1935.

The grant-of-aid program was started in 1938 but only one-half of 1 percent of the agricultural lime used that year was distributed by AAA. In 1939 AAA distribution was 8.5 percent of the total; in 1940, 24.4 percent; in 1941, 64.3 percent; and in 1942, 64.0 percent.

Serious Lag Exists in Postwar Road and Street Plans

MANY state and local government agencies are rapidly designing and blue-printing road and street projects, yet the general lag threatens the enlarged construction program urgently needed for postwar traffic and employment, according to Carl W. Brown, president of the American Road Builders' Association, and chief highway engineer of Missouri.

That conclusion was drawn after a study of early returns from nationwide surveys being made by the Association of the advance planning work of state, county, city and local highway agencies. "Two principal handicaps to planning confront the highway agencies," Mr. Brown explained, "shortage of manpower and lack of funds."

In general state highway departments have sufficient money for planning, for recently Congress made available $50,000,000 on a matching basis for state highway planning. Reports indicate that serious consideration is being given to advancing federal funds to local governments to stimulate planning.

"Highway construction, considered the foundation of durable goods production, cannot hold up its share of the postwar economy unless every effort is made now to get project plans in final shape to meet the urgent postwar needs," Mr. Brown said. "Every highway agency should be prepared to at least double its prewar program.

"To be well prepared for an employment emergency, the highway agency should have a stockpile of blueprints of three or four times a normal year's requirements. By so doing, insurance is taken out against the possibility of wasteful improvised relief work.

"The way is being pointed by several of the state highway departments. By next May the Texas State Highway Department will have plans ready and rights of way obtained for a program of $100,000,000, or four times the amount spent in 1941. In addition to directing the efforts of every available employee to planning, the department is employing women, high school students, older men and part time employees.

"Several highway agencies have contracted with firms of consulting engineers to handle major projects, particularly those involving elevated highways, bridges and grade separations.

"All levels of government must immediately start planning work if the road and street program is to be well balanced, fitted to actual needs, and made ready for the labor forces that must look to construction for jobs," concluded Mr. Brown.

—*"Postwar Highways."*

Hale Takes Over for Road Officials

MR. HAL H. HALE has assumed his duties as Executive Secretary of the American Association of State Highway Officials at Washington, D. C. headquarters.

Mr. Hale came to the AASHO from the American Society of Civil Engineers which he served as Washington Representative since 1941. Prior to that date he was Office Engineer in the Regional Headquarters of the Portland Cement Association at Atlanta, Georgia and earlier he served the City of Knoxville, Tennessee in various engineering capacities, being promoted to Chief Engineer in 1933. He is a native of Morristown, Tennessee.

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(*Continued from page 4*)

York State, will talk on, "The Development of New York's Postwar Highway Program." The remainder of the afternoon will be devoted to a panel discussion of proposed Federal-aid legislation for highways. The panel discussion will be opened by H. A. MacDonald, First Vice President of the American Association of State Highway Officials and Commissioner of the Department of Public Works of Massachusetts. Commissioner MacDonald will be followed by Wm. J. Cox, Commissioner of the State Highway Department of Connecticut. Commissioners MacDonald and Cox should do much in their presentations to clarify the issues in connection with Federal-aid for highways.

Come to New York prepared to participate in this highly important meeting. A most cordial welcome awaits you.

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